

**NEW SYNONYMS IN *COREOPSIS* L. AND NOTES
ON *C. SECT. PSEUDOAGARISTA*
(COMPOSITAE-HELIANTHEAE)**

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Abstract

New synonyms in *Coreopsis* sections *Pseudoagarista* and *Calliopsis* are provided. Keys to the sections of *Coreopsis* and to the species of *Coreopsis* sect. *Pseudoagarista* are also included. The latter section is poorly understood, and the key is preliminary, aimed to stimulate further research. A lectotype for *C. paludosa* M.E. Jones is selected.

Introduction

The genus *Coreopsis* L. is subdivided into 11 sections (Smith 1975), ten of which are found in North America while the eleventh section, *C. sect. Pseudoagarista* A. Gray, is represented in Mexico and South America. The systematic relationships between the sections and the species particularly within North America have been well documented (Crawford 1970, 1976, Crawford & Smith 1983 a & b, 1985, Jansen et al. 1987, Smith 1975, 1976, 1982, 1983, 1984; as examples). There have only been few additions to the list of species from North America, north of Mexico, since Sherff's revision of the genus in 1936 and Sharsmith's work in 1938 (e.g., Smith 1974, Parker in Smith 1975). A number of new species belonging to section *Pseudoagarista* and

derived particularly from the Andes in Peru have, however, been published since then (Crawford 1969, Sagastegui 1969, 1970, 1982, 1988, Sagastegui & Sanchez-Vega 1971, 1981, 1989, Sanchez-Vega et al. 1994, Turner 1986).

Currently about 45 species are recognized in *C. sect. Pseudoagarista*. This section of *Coreopsis* is unique in possessing taxa with invariable achene morphology but diverse foliar features. The achenes are oblanceolate to obovate with two erect, antrorsely barbed pappus awns, and numerous, long, twin-celled hairs all along the margins and often also medially on the ventral surface. The receptacular bracts (or paleae) are also unique in the genus in possessing these long, twin-celled hairs medially or all along the external surface, and also in being 2–3-cleft at the apex in some species. The paleae are detached and dispersed together with the achenes.

The South American species of *Coreopsis sect. Pseudoagarista* have been differentiated basically on foliar morphology and pubescence of phyllaries, leaves and internodes, although some of them have also been distinguished based on capitula and ray-floret sizes. The Mexican species, which also display a highly variable leaf morphology, are shown to be cross-compatible and interfertile (Crawford 1971). Preliminary hybridization studies on seven species from South America indicated that cross-incompatibility exists between all species except for *C. connata*–*C. senaria*, and *C. connata*–*C. obovatifolia* (Smith, unpublished data). These results, besides indicating the significance of continued studies on cross-compatibility and interfertility of the Andean taxa, also call for further studies into the relationships between the disjunct Mexican members and the Andean plants.

It is also necessary to do more field work particularly in the Andean region of South America, which is a major center of diversity of *Coreopsis sect. Pseudoagarista*. About 30–40 % of the species are described from the Department of Cajamarca, Province of Cajamarca in Peru (see list below). This group of *Coreopsis* thus offers a unique opportunity for studying speciation in isolated upland habitats if, as indicated above, many of the morphologically similar taxa happen to be cross-incompatible. Alternatively, the currently recognized taxa could represent differing populations of a few or several species situated at different altitudes and mountains with limited or no possibilities for gene exchange. Could they also be considered chromosomal or cytological races differing mainly in ploidy levels? - a phenomenon common in ferns. Chromosome numbers of $n = 13, 26$ and 39 are known in a few of the species (Smith et al. in press).

Studies on members of this section of *Coreopsis* are underway, and until a more thorough treatment is provided (it may probably represent a distinct genus), the correct names for certain taxa for which the types have been studied are provided here. A key to the sections of *Coreopsis* is also included to portray their relationships. The species so far described in *C. sect. Pseudoagarista* are collated and provided with remarks or

notes on presumed affinities. Sixteen of the species were published since the last revision of the genus. Many of the species are known from the types only or a few specimens. The authors of this paper would appreciate receiving fruits with voucher specimens of any of the species listed. Field notes on these taxa covering size of and observed variations in populations are highly sought after and solicited from botanists or collectors working particularly on the flora of Peru, Chile and Ecuador.

Coreopsis sect. *Pseudoagarista* A. Gray

Coreopsis capillacea H.B.K., Nov. Gen. Sp. 4:180 (1820); Sherff, Field Mus. Nat. Hist., Bot. 11:333 (1936). Type: Peru, Andes, Humboldt & Bonpland s.n. (P holotype, photo!).

Syn. *Coreopsis triloba* Blake, Contr. U.S. Nat. Herb. 22: 643 (1924); Sherff, Field Mus. Nat. Hist., Bot. 11: 334 (1936), **synon. nov.** Type: Ecuador, near Loxa, 1865, Jameson s.n. (US holotype, K isotype!).

Blake (loc. cit.) compared *C. triloba* with *C. capillacea* and stated that it "... may be distinguished by its lanceolate to lance-ovate outer phyllaries, only one-half as long as the inner, in *C. capillacea* lance-linear, two-thirds as long as the inner". In the key to the species of *Coreopsis*, Sherff (1936:291) distinguished *C. capillacea* from *C. triloba* on foliar features, viz. 'folia laxissime patentia vel etiam subreflexa' (for *C. capillacea*) and 'folia dense adgregata, subrecta' (for *C. triloba*). No other differential or diagnostic characters were cited in the description and the remarks accompanying it. Sherff (1936:334) cited the isotype of *C. triloba* from the herbarium at Kew (K) under *C. capillacea*. Close examination of specimens given under both names indicated that the alleged differences do not hold and that they all belong to one taxon.

Coreopsis venusta H.B.K., Nov. Gen. Sp. 4: 180/229 (1820); Sherff, Field Mus. Nat. Hist., Bot. 11: 328 (1936). Type: Ecuador, Prov. Loja, near Loja, Humboldt & Bonpland s.n. (P holotype, photo!).

Syn. *Coreopsis longula* Blake, Contr. U.S. Nat. Herb. 22: 642 (1924); Sherff, Field Mus. Nat. Hist., Bot. 11: 327 (1936), **synon. nov.** Type: Peru, Prov. Chachapoyas, 1835-1836, Mathews s.n. (GH holotype, K isotype!).

Blake (loc. cit.) related *C. longula* to *C. venusta* and indicated that the differences lie in some features of the leaves, capitula, peduncle and phyllaries (Table 1). As indicated in Table 1, the characters of *C. longula* fall within the range of variation of *C. venusta*. Leaf length varies continuously between 1.5 and 7 cm, and leaf width between 0.6 and 2.1 mm. The capitula are either solitary or in groups of two or three. The peduncle length and pubescence as well as the shape and pubescence of the outer phyllaries vary quite continuously. No other distinctive features were found.

Table 1. Comparisons between *C. venusta* and *C. longula* based on original descriptions, types and representative specimens

Characters	<i>C. venusta</i>		<i>C. longula</i>		Representative specimens					
	Blake	Sherff	Blake	Sherff	Type	J7283	E1380	M1739	L11235	B1419
1. Leaf length (cm)	3.7	1.5-4.0	2.5-7.0	4-7.5	2.3-4.	2.5-3.1	2.1-2.6	3.0-3.5	2.5-3.0	3.1-4.0
width (mm)	1.5	0.8-1.5	0.6-1.1	0.6-1.1	0.6-0. 8	0.6-1.1	1.1-1.8	1.5-2.1	0.6-0.8	1.0-1.2
2. Capitula	Sol.	Sol.	Sol.; 2/3's	?	2's	Sol.	Sol.	2's	Sol.	Sol.
3. Peduncle length (cm)	?	5-10	1-2	1-4	2.8-5.	1-6	1-3.3	c.2	4-7	3-7
pubescence (+/-)	?	-	+	?	5 +	-	.	+	+	+
4. O. phyll. shape	obl.	obl.	lan.-sub.	ob.-lin.	obl.	obl.- lanc.	ov.-lanc.	obl.	obl.- lanc.	obl.- ell.
pubescence (+/-)	?	+	+/-	-	+	+	-	+	+	+
5. Origin	Ecu.	-	Peru	-	-	Ecu.	Ecu.	Peru	Ecu.	Ecu.

Abbreviations:

Ecu. = Ecuador; lan.-sub. = lance-subulate; o.phyll. = outer phyllary; obl. = oblong; ob.-ell. = oblong-elliptic; ob.-lanc. = oblong-lanceolate; ob.-lin. = oblong-linear; ov.-lanc. = ovate-lanceolate; Sol. = solitary.

Specimens: B1419 = Balslev 1419; E1380 = Espinosa 1380; J7283 = Jaramillo 7283; L11235 = Lueyn & Cotton 11235; M1739 = Mostacero et al. 1739. (All from Field Museum of Natural History, Chicago).
+ = hairy; - = glabrous; ? = not indicated.

***Coreopsis* sect. *Calliopsis* (Reichenb.) Nutt.**

Coreopsis tinctoria Nutt., [var. *tinctoria*] Jour. Acad. Nat. Sci. Phil. 2: 114 (1821); Sherff, Field Mus. Nat. Hist., Bot. 11: 417 (1936); North Am. Fl. Ser. 2 (2): 30 (1955); Smith & Parker, Brittonia 23 (2): 168 (1971); Smith, SIDA 6 (3): 206, fig. 48-50 (1976); Cronquist, Vasc. Fl. S.E. U.S., 1: 57 (1980). *Diplosastera tinctoria* (Nutt.) Tausch, Hortus Canal. 16 pl. 4 (1823). *Calliopsis tinctoria* (Nutt.) DC., Prodr. 5: 568 (1836). Type: United States, Arkansas, Red River, Nuttall s.n. (GH holotype, BM isotype!).

Syn. *Coreopsis atkinsoniana* (Hook.) Dougl. in Lindl. Bot. Reg. 16: Plate 1736 (1830); Sherff, North Am. Fl. Ser. 2 (2): 33 (1955). *Coreopsis tinctoria* Nutt. var. *atkinsoniana* (Dougl.) H.M. Parker in Smith, Bot. Gaz. 136 (1): 83 (1975). *Calliopsis atkinsoniana* Hook. Fl. Bor.-Am. 1:311 (1833), **synon. nov.** Type: [British] Columbia, common on the sandy banks of the Colombia from Mewries [or Menzies] Island upwards, April 1825, Douglas s.n. (K isotype!).

Sherff (1955:33) maintained *C. atkinsoniana* Dougl. as distinct from *C. tinctoria* based on the winged nature of its achenes. In a biosystematic study of *C. tinctoria* and *C. cardaminefolia* DC., Smith & Parker (1971) indicated that "... the presence or absence of a wing on the achene is controlled by merely one (or two) locus (loci) ..." and redefined *C. tinctoria* to include taxa with winged achenes. An examination of the isotype of *C. atkinsoniana* revealed that the immature achenes are narrowly winged with the wings being either entire or irregularly lacerate. These resemble the F2 progeny found by Smith & Parker (1971) from the hybridization between *C. tinctoria* and *C. cardaminefolia*.

Coreopsis paludosa M. E. Jones, Contr. West. Bot. 12:46 (1908); Sherff, Field Mus. Nat. Hist. Bot. 11:434 (1936), North Am. Flora, ser. 2 (2): 35 (1955). Type: Mexico, State of Chihuahua, Sierra Madre, 2100 m, 17 Sept. 1903, Jones s.n. (RSA-POM lectotype!, selected here).

Syn. *Coreopsis maysillesii* Sherff, Brittonia 11: 188 (1959), **synon. nov.** Type: Mexico, Durango, 1900-2100 m, 26 road miles north of railroad at Coytes, on road to San Luis, Quebrada de San Juan, 9 Aug. 1955, Maysilles 8367 (MICH holotype, isotypes F, GH, K!, NY).

Sherff (loc. cit.) described *C. maysillesii* as an annual herb and compared it with *C. stenophylla* [F. Boynton], a name currently kept under synonymy in *C. tinctoria* Nutt. var. *tinctoria* (*Coreopsis* sect. *Calliopsis*; Smith 1976). The isotype of *C. maysillesii* at Kew has a woody base and probably represents a perennial species. Based on greenhouse grown materials which survived for two to four years, Smith (1983:551) considered *C. paludosa* as a perennial species. The only other specimen

seen of this rare species, Melchert et al. 68-20 (OS), definitely represents a perennial species.

Smith (1975:80, Table 1) suggested the inclusion of *C. maysillesii* in *C. paludosa* but no formal synonymy was made in that or his other subsequent works. The achenes of the types of *C. paludosa* and *C. maysillesii* are epappose and have pectinate wings similar to those of species in *C. sect. Eublepharis* (Smith 1983:551, fig. 2 D and E). However, the reported base number of $x = 12$ for *C. paludosa* (Smith 1985) precludes its inclusion in that section. The phyletic relationships between sections *Eublepharis* and *Calliopsis* were studied by Smith (1983), who maintained these on differences in the basic chromosome number and the nature of the achene wings, i.e., $x = 13$ and achene margins pectinate for *C. sect. Eublepharis*; $x = 12$ and achene wings entire for *C. sect. Calliopsis*. The genetic affinities of the three species in *C. sect. Calliopsis* were studied by Crawford et al. (1984), who showed that *C. paludosa* has lowered genetic affinities to either of the species in the section. In gross vegetative morphology, *C. paludosa* is similar to *C. falcata* F. Boynton of section *Eublepharis*, but this has a south-east North American distribution. Thus, *C. paludosa* seems to connect the two sections of *Coreopsis* in south-eastern and south-western North America.

Key to the sections of *Coreopsis* L.

1. Achenes and paleae densely covered with long, twin-celled, white or light brownish hairs; achenes oblanceolate to obovate with 2(-3) antorsely barbed pappus awns, wingless; phyllaries often pubescent to tomentose Sect. *Pseudoagarista*
- Achenes usually glabrous or verrucose, rarely with short simple or gland-tipped multicellular hairs, or with long, twin-celled hairs along the margins; paleae glabrous; achenes obovate, oblong-elliptic, oblong to orbicular, epappose or shortly pappose, usually winged; outer phyllaries glabrous or sparsely ciliate at base or along margins; inner phyllaries usually glabrous 2
2. Leaves simple, ovate to ovate-elliptic, margins serrate, mostly 10–25 x 3.5–10.5 cm; ray-florets lemon yellow, usually 5 Sect. *Silphidium*
- Leaves not with the above combined features; ray-florets yellow or orange with or without reddish/purplish blotches at base, usually 8, rarely 5 3
3. Ray-florets elliptic, oblong-elliptic to lanceolate, minutely 2–3-fid at the apex, concolorous and pale to bright yellow 4

- Ray-florets cuneate-obovate to oblanceolate, deeply 3–4-lobed at the apex with the median lobe often bilobed and also the longest, or trullate and undulate, concolorous or with dark red/purple blotches at the base or in the middle 7
- 4. Ray-florets neuter; style arm apices acute, often with decurrent sweeping hairs; paleae narrowly spatulate Sect. *Palmatae*
- Ray-florets pistillate; style arm apices cuspidate with limited sweeping hairs; paleae oblong-linear to oblanceolate 5
- 5. Leaves alternate, fleshy, clustered at apices of branches; ray-florets 10–20, 20–40 mm long; erect perennial herbs of coastal California and adjacent islands Sect. *Tuckermannia*
- Leaves opposite, herbaceous to slightly fleshy, uniformly dispersed on stem or branches; ray-florets 5–7, 2–9 mm long; shrubs or perennial herbs of montane habitats in Mexico 6
- 6. Leaves ovate, obovate, oblanceolate, ovate-lanceolate, or oblong-ovate, serrate; receptacle flat; tube of disc-floret corolla pubescent on outside Sect. *Electra*
- Leaves or leaf segments linear to linear-filiform, entire; receptacle conic; tube of disc-floret corolla glabrous Sect. *Anathysana*
- 7. Leaves alternate or crowded at the stem base; capitula solitary; ray-florets pistillate, truncate to shallowly 3-lobed; disc-floret corolla constricted in middle and pubescent; paleae oblong-lanceolate 8
- Leaves opposite; capitula cymose or corymbose; ray-florets sterile, deeply 3–4-lobed; disc-floret corolla not constricted and pubescent in middle; paleae narrowly linear with attenuate or spatulate apex 9
- 8. Disc-floret achenes oblanceolate, glabrous or with short, tubercle-based or glandular hairs, exaristate Sect. *Leptosyne*
- Disc-floret achenes oblong-elliptic with long, twin-celled hairs along the margins; pappus awns 2, paleaceous, flat, antrorsely hispid Sect. *Pugiopappus*
- 9. Disc-floret corolla 5-lobed; leaves opposite Sect. *Coreopsis*
- Disc-floret corolla 4-lobed; leaves alternate or opposite 10
- 10. Achenes oblong-elliptic, outer surface rounded, inner surface flat, wings entire to pectinate; leaves opposite (rarely alternate), simple to pinnatifid; paleae linear-attenuate ($x = 12$) Sect. *Calliopsis*

- Achenes oblong, flattish, wings deeply fimbriate-lacerate; leaves simple to auricled; paleae linear, oblanceolate to spatulate ($x = 13$)

.....Sect. *Eublepharis*

Taxa in *C. sect. Pseudoagarista* A. Gray

C. breviligulata Sagast. & Sanchez (1981). Type: Peru, Dept. Cajamarca, Prov. Cajamarca, between San Marcos and Matara (bajada a Guayobamba), 2400 m, 6 May 1973, Sanchez Vega 1130 (HUT holotype, Herb. Cazamarques, isotype). Sagastegui & Sanchez (1981:225) compared it with *C. peruviana*. The differences lie in texture of leaves, size of capitula and shape of ray-florets.

C. cajamarcana Sagast. & Sanchez (1989). Type: Peru, Dept. Cajamarca, Pullucana (Banos del Inca-La Encanada), 2700 m, 17 June 1975, Sagastegui, Cabanillas & O. Dios 8064 (Herbario de la Universidad Anterior Orrego de Trujillo, holotype). Sagastegui & Sanchez (1989: 24) related this to *C. senaria*. The differences lie in the achenes, size of leaves, and phyllaries.

C. canescentifolia Sagast. (1988). Type: Peru, Dept. Cajamarca, Prov. Celendin, La Tranca (alrededores de Celendin), 2700 m, 21 May 1976, Sagastegui, Cabanillas & O. Dios 8498 (HUT holotype). Sagastegui (1988:51) related this to *C. holodasya* and *C. pervelutina*. The similarities are in leaf type, i.e. entire or simple, and the differences lie in the shape of the upper leaves and their pubescence.

C. capillacea H.B.K. (1820). Type: ?Peru, Andes, Humboldt & Bonpland (P holotype). Compare with *C. fasciculata* and *C. townsendii*.

C. celendinensis Sagast. & Sanchez (1971). Type: Peru, Dept. Cajamarca, Prov. Celendin, La Chocta-Oxamarca road, 3300 m, 30 July 1970, Sanchez s.n. (HUT holotype, Caxamarques, LP, isotypes). Sagastegui & Sanchez (1971:340) compared it with *C. connata* and listed a number of differences in leaf shape, dentation, capitula size, number of nerves on outer phyllaries and paleae and shape of ray-florets.

C. connata Cabrera (1962). Type: Peru, Dept. Cajamarca, Prov. Celendin, La Tranca, 2600 m, 22 May 1960, Lopez & Sagastegui 3124 (LP holotype). Compare with *C. helleborifolia*.

C. dentifolia Sanchez, Sagast. & Crawford (1994). Type: Peru, Dept. Cajamarca, Prov. Chota, District Paccha, c. 1 km E of Paccha, 2000 m, 21 July 1993, Sanchez V. 6559 (CPUN holotype, F, HAO, MO, OS, isotypes). Sanchez et al. (1994:39) stated that it is different from the other Peruvian species on account of its petiolate leaves with ovate lamina and related it to *C. canescentifolia* and *C. pervelutina* (but compare with *C. woytkowskii*).

C. dilloniana Sanchez, Sagast. & Crawford (1994). Type: Peru, Dept. Cajamarca, Prov. Hualgayoc, 5–6 km S. of Bambamarca, c. 2780 m, 22 April 1993, Dillon & Sanchez V. 6471 (F holotype, CPUN, HAO, OS, isotypes). Sanchez et al. (1994:42) related it to *C. lopez-mirandae*, but compare also with *C. woytkowskii*.

C. fasciculata Wedd. (1855). Type: Peru, Gay s.n. (P holotype). Compare with *C. pickeringii* and *C. townsendii*.

C. fasciculata Wedd. var *laevigata* Sherff (1935). Type: Peru, Cuzco, 3400–3600 m, Herrera 111 (B holotype). Compare with *C. notha* var *parvulifolia*.

C. ferreyrae Sagast. & Sanchez (1989). Type: Peru, Dept. Cajamarca, Prov. Celendin, Hacienda Limon, 2150 m, 5 May 1970, Sagastegui 7416 (HUT holotype, CPUN, F, isotypes). A species noted for its much dissected leaves with xeromorphic aspect.

C. foliosa A. Gray (1861). Type: Peru, Taulia, 1835, Mathews 1376 (K holotype). Compare with *C. nodosa*.

C. glaucodes Blake & Sherff ex Sherff (1925). Type: Peru, Dept. Cajamarca, below Hacienda La Tahona, 2600 m, near Hualgayoc, 15 May 1904, Weberbauer 4048 (B holotype, US isotype).

C. helleborifolia Sanchez, Sagast. & Crawford (1994). Type: Peru, Dept. Cajamarca, Prov. San Marcos, between Chancay and Condebamba valley, 2600 m, 26 March 1994, Sanchez & Sanchez 6923 (CPUN holotype, HAO, HUT, F, MO, OS, isotypes). Sanchez et al. (1994:44) related it to *C. breviligulata*, but compare with *C. connata*.

C. holodasya Blake ex Parker (1962). Type: Peru, Dept. Apurimac, Saihuiti, 4270 m, 14 May 1939, Balls 6846 (K holotype, US isotype).

C. imbricata Sherff (1930). Type: Peru, Cordillera Huante, between Lima and Cuzco, 3600 m, Feb. 1867, Pearce s.n. (K holotype). Sherff (1930:371) related this to *C. pickeringii* and noted that "... it differs in its numerous, much shorter internodes, its lack of elongate peduncles, the caudate-tipped stigmas of its disk florets, its double outer involucre the bracts of which are larger (with a most noticeable imbricate appearance), etc."

C. integra Blake (1937). Type: Peru, Dept. Huanuco, Sawn Carlos Mines, 6 miles west of Huallanca, 2745 m, 30 Sept. 1922, Macbride & Featherstone 2469 (F holotype, US isotype). Blake (1937:386) compared it with *C. longula* which is now a synonym of *C. venusta*.

C. irmscheriana Bruns (1929). Type: Peru, Lomas, Mejia, Ravine of Chule, 30 m, 12 Nov. 1923, Guenther & Buchtien 55 (HBG holotype, M isotype). This is the only annual species in this section, and it is so far known only from the type specimen; note the altitude; more specimens needed.

C. killipii Sherff (1933). Type: Peru, Dept. Junin, Tarma, 3000–3200 m, 20–22 April 1929, Killip & Smith 21823 (F holotype). Sherff (1933:595) related this to *C. macbridei* and *C. notha* and stated that it differs from the former "... in having smaller leaves, fewer and much larger heads, and also comparatively (and actually) much larger exterior involucre bracts, etc." and from the latter "... it differs in having smaller leaves, linear-oblong (not lanceolate to oblong) leaf segments, about 8 (not 6) exterior involucre bracts, these 3–5 (not 2–3) mm long, etc."

C. lopez-mirandae Sagast. (1969). Type: Peru, Dept. Amazonas, Prov. Chachapoyas, between Paso de Calla-Calla and Balsas, 3000 m, 1 June 1963, Lopez, Sagastegui & Collantes 4460 (HUT holotype, LP isotype). Sagastegui (1969:250) compared it with *C. woytowskii* and noted differences in leaf margins and shape, inflorescence type, shape, nerve number and apical features of outer phyllaries and apex of paleae.

C. macbridei Sherff (1930). Type: Peru, Huanuco, 2100 m, 26 April 1923, Macbride 3504 (F holotype, US isotype). Compare with *C. townsendii*.

C. mcvaughii Crawford (1969). Type: Mexico, Aguascalientes, Sierra del Laurel, c. 10 m. SE of Calvillo, McVaugh & Koelz 225 (MICH holotype, MICH isotype).

C. microlepis Blake & Sherff ex Sherff (1925). Type: Peru, Dept. Amazonas, Prov. Chachapoyas, 1835–1836, Mathews 1418 (K holotype, US isotype). Sherff (1925:372) related this to *C. foliosa*, *C. glaucodes* and *C. parviceps*.

C. nodosa (1933). Type: Peru, Dept. Cuzco, Ollantaitambo, 2900–3100 m, 26 April 1925, Pennell 13646 (F holotype).

C. notha Blake & Sherff ex Sherff (1925). Type: Peru, Dept. Cajamarca, Prov. Cajamarca, above San Pablo, 2500–2700 m, 26 April 1904, Weberbauer 3812 (B holotype, US isotype). Sherff (1925: 373) wrote that it is near *C. spectabilis*, but compare with *C. foliosa*.

C. notha Blake & Sherff ex Sherff var. *parvulifolia* Sherff (1935). Type: Peru, Dept. Cajamarca, Prov. Contumaza, Contumaza, 1875, Raimondi 6695 (B holotype). Sherff (1935:707) noted this to be similar to *C. fasciculata* var. *laevigata*.

C. oblanceolata Blake (1924). Type: Peru, western Cordillera, opposite Huanabamba, 2400–2850 m, 26 Sept. 1911, Townsend A211 (F holotype).

C. obovatifolia Sagast. (1982). Type: Peru, Dept. Cajamarca, Prov. Cajamarca, La Encanada, 2600 m, 17 Aug. 1973, Sagastegui 7771 (HUT holotype). Sagastegui (1982:265) related this to *C. oblanceolata*.

C. parviceps Blake & Sherff ex Sherff (1925). Type: Peru, Tambillo, 19 Aug. 1878, De Jelski 765 (B holotype, US isotype). Sherff (1925:369) related this to *C. foliosa* and *C. glaucodes* and stated that it differs in leaf dissection and pubescence, and shape and pubescence of the outer phyllaries.

C. peruviana Sagast. (1970). Type: Peru, Dept. Cajamarca, Prov. Celendin, 3050 m, 8 May 1970, Sagastegui 7495 (HUT holotype, Herb. Caxamarques, isotype).

C. pervelutina Sagast. (1982). Type: Peru, Dept. Cajamarca, Prov. Bambamarca, between Bambamarca and Hualgayoc, 2900 m, 7 Aug. 1973, Sanchez V. 1198 (HUT holotype, Herb. Caxamarques, isotype). Sagastegui (1982:267) related it to *C. holodasya*, but compare also with *C. canescentifolia*.

C. petrophila A. Gray ex S. Watson (1887). Type: Mexico, Jalisco, Rio Blanco, Palmer 530 (US holotype, GH, MO, NY, UC, US, isotypes).

C. petrophiloides Robinson & Greenman (1894). Type: Mexico, Jalisco, Nevado de Colima, Pringle 5508 (GH holotype).

C. pickeringii A. Gray (1861). Type: Peru, Dept. Lima, above Osrajillo, U.S. Exploring Expedition under Captain Wilkes s.n. (US holotype). Compare with *C. townsendii*.

C. piurana Sherff (1964). Type: Peru, Dept. Piura, near Huancabamba, May 1958, Soukup H662 (US holotype). Sherff (1964:371) traced this to *C. pickeringii* in his key to *Coreopsis* (Sherff 1936) and stated that the two plants are different. Unfortunately the most important differences in many members of this section, i.e., leaf characteristics, are omitted from the description.

C. polyactis Blake & Sherff ex Sherff (1925). Type: Peru, Dept. La Libertad, Prov. Otuzco, 3500–3600 m, between hacienda Llaguess and Suchabamba, 28 June 1914, Weberbauer 6995 (B holotype, US isotype).

C. pringlei Robinson (1907). Type: Mexico, Queretaro, San Juan del Rio, Pringle 10050 (GH holotype, F, MICH, MO, NY, US, isotypes).

C. queretarensis B.L. Turner (1986). Type: Mexico, Queretaro, Mpio. Penamiller, Maguey Verde, 17 km SE of Pinal de Amoles, 2170 m, 22 Oct. 1982, Tenorio & Romero 2353 (TEX holotype, MEXU isotype).

C. rhyacophila Greenman (1900). Type: Mexico, Morelos, near Cuernavaca, Pringle 7866 (GH holotype).

C. rudis (Bentham) Hemsley (1881). Type: Mexico, Jalisco, Bolanos, Canton of Colotan, 1836–1838, Hartweg 116 (K holotype, B, GH, K, isotypes).

C. senaria Blake & Sherff ex Sherff (1925). Type: Peru, Pacasmayo to Moyobamba, April–June 1875, Stubel 35 p.p. (B holotype, US isotype).

C. sherffii Blake (1937). Type: Peru, Dept. Huanuco, Chinchapalca, 6 miles above Mito, 2900 m, 16-27 July 1922, Macbride & Featherstone 1596 (F holotype, US isotype). Blake (1937:387) compared it with *C. microlepis*.

C. spectabilis A. Gray (1861). Type: Peru, Andes, McLean s.n. (K holotype).

C. suaveolens Sherff (1930). Type: Chile, Dept. Tarapaca, Prov. Tarapaca, Cordillera de Lallinca, 3800 m, March 1926, Werdermann 1114 (GH holotype, F, S, UC, isotypes). Sherff (1930:369) related this to *C. fasciculata*.

C. suaveolens Sherff var. *ecuadoriensis* Sherff (1964). Type: Ecuador, Prov. Azuay, Paramos de Silvan, Nudo de Cordillera occidental y Cordillera oriental, 3000 m, 30 July–3 Aug. 1959, Barclay & Juajibioy 8563 (US holotype).

C. townsendii Blake (1924). Type: Peru, Huascaray, 1950–2250 m, 10 Sept. 1911, Townsend A 192 (F holotype).

C. venusta H.B.K. (1820). Type: Ecuador, Prov. Loja, near Loja, Humboldt & Bonpland s.n. (P holotype, B isotype).

C. woytkowskii Sherff (1936). Type: Peru, Dept. Cajamarca, Prov. Celendin, 2625 m, 5 June 1936, Woytkowski 24 (F holotype).

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Appendix

A preliminary key to *Coreopsis* sect. *Pseudoagarista* A. Gray

1. Annual herbs; leaves simple, ovate to ovate-lanceolate, serrate*C. irmscheriana*
- Shrubs, subshrubs or perennial herbs; leaves simple to thrice pinnatisect, margins entire to coarsely serrate 2
2. Leaves simple, margins entire or serrate..... 3
- Leaves 3-lobed to thrice-pinnatisect 15
3. Leaf margins serrate to incised 4
- Leaf margins entire, sometimes thickened and inflexed or purple lined..... 8
4. Leaves rounded or orbicular to ovate, sessile, margins regularly serrate to grossly serrate-lobed..... 5
- Leaves oblanceolate, obovate, linear, linear-elliptic, subulate or ovate-elliptic 6
5. Capitula solitary or 1–3 per branch; ray-florets 8–10 × 4.4–6 mm; outer phyllaries obovate-spathulate, about equal to the inner ones*C. connata*
- Capitula 3-18, cymosely arranged, ray-florets 3–3.5 × 2–2.5 mm; outer phyllaries oblong-linear, 1/3 to 1/2 of the inner ones*C. helleborifolia*
6. Ray-florets 8.5–10 × 5–5.5 mm; capitula 28–32 mm wide at anthesis.. *C. dentifolia*
- Ray-florets 14–25 × 7–10 mm; capitula 30–50 mm at anthesis 7
7. Leaves ovate-elliptic to oblanceolate, margins regularly serrate or serrate only near the apex; outer phyllaries densely pubescent on both surfaces; inner phyllaries pubescent on outer surface; achenes 6–10 mm long *C. woytkowskii*
- Leaves oblanceolate, margins entire, apex 3–5-lobed or incised; phyllaries glabrous except for the ciliate margins on outer ones; achenes 3.7–5 mm long*C. lopez-mirandae*
8. Leaves densely appressed tomentose, gray green..... 9
- Leaves glabrous or glabrescent, sometimes ciliate on margins, dark or bright green 11
9. Both outer and inner phyllaries densely pilose to tomentose except near the apex; leaves sessile, broadly linear or linear-lanceolate,

- silvery tomentose, hairs silky; upper branch internodes densely woolly *C. holodasya*
- Outer phyllaries densely appressed tomentose; inner phyllaries glabrous to tomentose; leaves subpetiolate, densely tomentose 10
10. Leaves ovate to ovate-lanceolate; achenes 4–5 mm long *C. pervelutina*
- Leaves oblong, oblong-elliptic to oblanceolate; achenes 7–8 mm long *C. canescentifolia*
11. Leaves ovate, ovate-elliptic, obovate or oblanceolate 12
- Leaves linear, subulate, or narrowly elliptic 14
12. Leaves ovate or ovate-elliptic, sessile or subsessile, 10–25 mm wide, 3–5-nerved from base; outer phyllaries 7–12.5 x 3.5–6 mm *C. celendinensis*
- Leaves obovate or oblanceolate, lamina narrowed below into a broad pseudo-petiole, 3–10 (–12) mm wide, usually 1-nerved; outer phyllaries 4–7 x 1.2–3 mm 13
13. Leaves 3–6 mm wide; involucre sparsely ciliate; outer phyllaries 1.2–1.7 mm wide, ciliate on margins; inner phyllaries 1.5–2.5 mm wide *C. oblanceolata*
- Leaves 3–12 mm wide; involucre and phyllaries glabrous; outer phyllaries 2–3 mm wide; inner phyllaries 2.5–3.5 mm wide *C. obovatifolia*
14. Leaves linear or subulate 1–3 (–4.5) cm long, 1–1.5 mm wide at base; margins glabrous to ciliate; outer phyllaries oblong-linear, densely pilose, apex acute *C. integra*
- Leaves narrowly elliptic to narrowly oblanceolate, often 3–6 cm long, 1.5–3 mm wide; outer phyllaries ovate to elliptic, glabrous to tomentose, apex obtuse *C. venusta*
15. Leaves sessile to subsessile, deeply palmately 3-lobed, the lateral leaflets continuous with the inter-petiole cupule and much shorter than the internodes 16
- Leaves petiolate or pseudopetiolate with 3 veins running into the base of the lamina; petiole or pseudopetiole 4–30 mm long 17
16. Outer phyllaries linear, subulate, imbricate, continuous with the bracts on peduncle; terminal leaflets c. 1 mm wide *C. senaria*
- Outer phyllaries oblong, distinct not continuous with bracts on the peduncle *C. cajamarcana*

17. Involucre 2–4 mm wide at anthesis; ray-florets 5 (–6) *C. petrophila*
 - Involucre (4–) 5–10 mm wide at anthesis; ray-florets (6–) 8 (–9) 18
18. Leaves palmately 3-lobed or 3-partite, lateral segments oblong-elliptic, entire or minutely lobed near the apex, terminal or middle segments cuneate-obovate or oblanceolate, simple or shallowly 3-lobed at the apex 19
 - Leaves grossly serrate, pinnatilobed with irregularly serrate or lobed segments or 3–7-pinnate to thrice-pinnatisect with linear or narrowly elliptic segments 25
19. Terminal leaf segment 1–2 mm wide below the apical lobes, lateral segments 1–1.5 mm wide; leaves in axillary fascicles *C. sherffii*
 - Terminal leaf segments 2.5–10 mm wide below the apical lobes, lateral segments 2–6.5 mm wide; leaves not fascicled 20
20. Outer phyllaries 5–7 × 3.3–4.8 mm, densely pubescent, foliaceous; inner phyllaries 10–14 mm long; capitula 30–35 mm wide at anthesis. *C. polyactis*
 - Outer phyllaries 2–4 × 0.1–1 mm, glabrous, coriaceous; inner phyllaries 5–8 mm long; capitula 15–25 mm wide at anthesis 21
21. Ray-florets 3.5–5 mm long *C. breviligulata*
 - Ray-florets 7–10 mm long 22
22. Outer phyllaries 3.5–4 mm long, oblong, glabrous *C. peruviana*
 - Outer phyllaries 1.5–3 mm long, ovate, linear or linear-oblong 23
23. Capitula solitary, on up to 3 cm long peduncles; leaf segments linear or linear-elliptic, 8–19 × 1.5–3 mm *C. parviceps*
 - Capitula cymose, rarely solitary, peduncle 1.5–6.5 cm long; leaf segments cuneate, elliptic-obovate, spatulate, oblanceolate, linear-lanceolate or lanceolate 24
24. Achenes 4–4.5 × 1–1.2 mm; pappus 0.8–1.2 mm long; capitula 3–15 per branch; base of phyllaries and peduncle pubescent *C. microlepis*
 - Achenes 3.5–4 × 1.8 mm; pappus 1.5–2 mm long; capitula 1–7 per branch; phyllaries and peduncle glabrous *C. glaucodes*
25. Outer phyllaries herbaceous, usually 3/4 of inner ones to slightly longer, rarely only 1/2 as long as the inner ones; inner phyllaries membranous; plants of Mexico 26

- Outer phyllaries leathery, often 1/4–3/4 of inner ones; inner phyllaries usually coriaceous; plants of South America..... 31
- 26. Plant sparsely to densely hispid-pilose..... 27
 - Plant glabrous, glabrescent to sparsely ciliate..... 29
- 27. Leaves bipinnatisect; involucre 6–8 x 8–10 mm at anthesis, up to 7 x 13 mm in fruit *C. sp. A*
 - Leaves pinnatilobed, lobes grossly serrate; involucre 4–5 x 5–6 mm at anthesis, up to 7 x 9 mm in fruit 28
- 28. Outer phyllaries spatulate, equal to or longer than the inner ones; disc-florets 40–60 per capitulum..... *C. mcvaughii*
 - Outer phyllaries linear-lanceolate, c. 1/2–3/4 of inner ones; disc-florets c. 35 per capitulum *C. rudis*
- 29. Leaves simple, or, if lobed or dissected, segments more than 5 mm wide..... *C. petrophiloides*
 - Leaves bipinnatifid to tri-pinnatisect, segments less than 5 mm wide 30
- 30. Leaves bipinnatifid, segments 0.5–1 mm wide; ray-florets lamina 10–14 x 4–6 mm; capitula 20–30 mm wide at anthesis *C. pringlei*
 - Leaves bi- to tri-pinnatisect, segments 1–3 mm wide; ray-florets 15–25 x 6.5–8.5 mm; capitula 30–35 mm wide *C. rhyacophila*
- 31. Internodes of young shoots short (5–10 mm long), hispid-pilose..... 32
 - Internodes short or long, glabrous or glabrescent, hairs, if present, usually restricted to the interpetiolar region..... 33
- 32. Hairs on internodes and peduncle dense, eglandular; phyllaries usually pubescent at least at base or on margins; terminal leaflets 4–6 mm long *C. foliosa*
 - Hairs on internodes and peduncle sparse, short, capitate-glandular; phyllaries glabrous; terminal leaflets 2–4 mm long (usually whole leaf and leaflets much smaller than in *C. foliosa*)..... *C. nodosa*
- 33. Peduncle and/or phyllaries sparsely to densely pilose 34
 - Peduncle and phyllaries glabrous or glabrescent 48
- 34. Both peduncle and phyllaries pilose 35
 - At least outer or inner phyllaries or both glabrous..... 44

35. Capitula 35–50 x 9–11 mm wide at anthesis; inner phyllaries 9–11 mm long 36
- Capitula 12–34 (–38) x 5–9 (–10) mm at anthesis; inner phyllaries 7–9 mm long 39
36. Peduncle 5–10 mm long; outer phyllaries 6–8 mm long; leaf segments 0.3–0.6 mm wide 37
- Peduncle 50–150 (–230) mm long; outer phyllaries 4–6 mm long; leaf segments 0.5–1.5 mm wide 38
37. Leaves pinnately 3–5-lobed, ciliate on margins, all exceeding internodes; outer phyllaries broadly ovate-lanceolate, 5–7-veined, 3–4 mm wide *C. polyactis*
- Leaves ternately bipinnatisect, glabrous except for tufts of hairs at petiole bases; outer phyllaries oblong, 3–5-veined, 1.1–1.6 mm wide *C. imbricata*
38. Inner phyllaries pilose at least at base; capitula 35–50 mm wide at anthesis, leaves 20–35 mm long *C. pickeringii*
- Inner phyllaries glabrous; capitula 12–38 mm wide at anthesis; leaves 30–60 mm long *C. capillacea*
39. Ray-floret lamina 8–9 x 5.5–6.5 mm; involucre 5–11 x 5–7 mm at anthesis *C. dilloniana*
- Ray-floret lamina 14–17 x 5–8 mm; involucre c. 10 x 12 mm at anthesis 40
40. Capitula 5–7 mm wide at anthesis; outer phyllaries 2.5–4.5 mm long 41
- Capitula 7–11 mm wide at anthesis; outer phyllaries 4–7 mm long 42
41. Petiole 5–10 mm long; outer phyllaries glabrous or pubescent; inner phyllaries glabrous *C. fasciculata*
- Petiole 10–25 mm long; outer phyllaries sparsely pubescent at base; inner phyllaries sparsely pubescent *C. townsendii*
42. Leaves 30–60 mm long; peduncle 50–100 mm long; inner phyllaries glabrous *C. capillacea*
- Leaves 12–25 mm long; peduncle 20–30 (–50) mm long; inner phyllaries pilose 43

43. Ray-floret lamina 7–11 mm long; capitula up to 23 mm wide at anthesis..... *C. suaveolens*
- Ray-floret lamina c. 15 mm long; capitula 25–30 mm wide..... *C. piurana*
44. Ray-floret lamina 7.5–14 x 3–6.5 mm 45
- Ray-floret lamina 15–23 x 7–10.5 mm..... 46
45. Leaf segments 2–6 mm wide; outer phyllaries 1.5–2 mm long; ray-floret lamina 7–9 x 3–5 mm *C. microlepis*
- Leaf segments 0.3–1 mm wide; outer phyllaries 2.5–4.7 mm long; ray-florets 10–14 x 5–6.5 mm..... *C. capillacea*
46. Capitula 5–7 mm wide at anthesis; petiole 5–10 mm long..... *C. fasciculata*
- Capitula 8–13 mm wide at anthesis; petiole 10–20 mm long..... 47
47. Outer phyllaries glabrous; leaf segments 1–3 mm wide..... *C. notha*
- Outer phyllaries pubescent; leaf segments 0.5–1 mm wide..... *C. capillacea*
48. Peduncle swollen near base of receptacle, 220–270 mm long; capitula 35–40 mm wide at anthesis; ray-floret lamina 15–18 x 10 mm *C. spectabilis*
- Peduncle uniform throughout, 10–120 mm long; capitula 20–28 mm wide at anthesis; ray-floret lamina 8–12 x 1.5–7 mm..... 49
49. Leaves bipinnate with the terminal segment equal to the laterals; involucre glabrous; outer phyllaries triangular *C. ferreyrae*
- Leaves pinnate with the terminal segment equal to or longer than the laterals; involucre bearded or sparsely pilose; outer phyllaries oblong-linear 50
50. Capitula several to numerous, in corymbose cymes; peduncle 1.5–5.5 cm long; terminal leaf segment much longer than the laterals..... *C. macbridei*
- Capitula solitary or in 2's or 3's; peduncle up to 12 cm long; terminal leaf segment equal to or only slightly longer than the laterals..... *C. killipii*